



On the mating behaviour of captive Indian pangolin (*Manis crassicaudata*)

The Indian pangolin, *Manis crassicaudata* is under serious threat due to hunting for local consumption and for international trade in skins, scales and meat, and to a lesser extent, loss and deterioration of its habitat (Mishra & Panda, 2012; Baillie *et al.*, 2014). This species is listed as ‘Endangered’ (Baillie *et al.*, 2014) and included under Appendix II of CITES. Because of their nocturnal, burrowing and secretive nature (Prater, 2005; Mishra & Panda, 2012), information on their biology in the wild is very limited. They are difficult to maintain and rarely breed in captivity. Although several zoos have maintained this species, births in captivity have been reported by very few zoos: Calcutta zoo, (Acharjyo, 2000), Oklahoma zoo (Ogilvie & Bridgwater, 1967), Nandankanan Zoological Park, (Acharjyo & Misra, 1972, Acharjyo & Mohapatra, 1978). Although earlier studies have described nocturnal behaviour and activity pattern of Indian pangolins in captivity (Mishra & Panda, 2010; Mohapatra & Panda, 2013), observations on their mating behaviour are limited mainly because mating is seldom observed. This study reports on mating behaviour observed in captivity.

The study was conducted at the “Pangolin Conservation Breeding Centre” (PCBC) of Nandankanan Zoological Park, Odisha, India. The housing and husbandry practices for Indian pangolins at PCBC have been described elsewhere (Mohapatra & Panda, 2013; Mohapatra & Panda, 2014). At PCBC, Indian pangolins are housed in such a way that they have the opportunity to interact with individuals of the opposite sex in the adjacent enclosure by climbing up mounds, the surrounds of water pools, wooden logs, or the chain-link mesh. On 23 and 25 February, 2014 a male (Microchip ID–98102058378) and a female (Microchip ID–00074D5A63) in adjacent enclosures were

found interacting with each other. Those interactions included; standing or lying near chain-link mesh, looking at and smelling each other, and squirting urine. Assuming this as a sign of compatibility and courtship, the pair was shifted to a concrete floored enclosure to facilitate observation. The male pangolin was introduced to the enclosure where the female was kept during the night between 19:00 h and 01:00 h for three consecutive days, from 25 February 2014 to 27 February 2014. Observations were carried out by digital video recordings through infra red enabled CCTV (close circuit television) using focal behavioural sampling, i.e., continuous behavioural observation which records each sample period for each focal individual (Altmann, 1974).

Observed behaviour was categorised into one of the following categories: (1) ‘exploration’– one pangolin approaches the opposite sex individual and exhibits naso–genital inspection and sniffing the other individual; (2) ‘chasing’– one individual moving towards or walking closely behind the other; (3) ‘mounting’– male climbs up the female’s back from rear or side with his forelimb with claws holding the female; (4) ‘copulation’– insertion of male genitalia in to the female’s genitalia; (5) ‘retreat’– a pangolin attains a coiled posture lying on the substrate or climbing and clinging on the chain-link mesh/tree trunk as avoidance; (6) ‘clawing’– male coiled around the female and trying to uncoil her with the claws of his forelimbs; (7) ‘no interaction’– behaviours that do not include interaction of both individuals, e.g. walking separately or feeding. Total time spent, bout duration and frequency of the different behavioural categories were measured. In addition, mounting latency (time from introduction of a male to the first mounting) and intromission latency (time from introduction of a male to the first copulation) were determined. The maximum and minimum temperatures recorded inside the enclosure were 33.3 °C and 22.1 °C respectively.

A total of 26 mounting events without intromission and a single copulation event that included intromission were observed. Details of time spent in different behaviours during the three observational nights are given in Table 1. The mating pair was initially not comfortable when they were housed together, but after about half an hour the male started following the female and sniffing her external genitalia (Fig. 1D). The male made a series of mounts and repeatedly attempted to achieve an ideal state of copulation with the female. Observed mounting latency (time period between when the two individuals first sensed each other's presence and the first mounting attempt) was 16.3 ± 4.5 minutes (12–21 minutes) during three observational nights. During mounting, the male would climb up the female's back from the rear or side with his claws of forelimb holding her body. Thereafter, the male fully extended his neck and the mounting pair remained parallel to each other (Fig. 1E). The male would then adjust his relative position with the female to attain an ideal copulation state. Mounting behaviour may contribute toward testing the receptiveness of the female for copulation; thereafter both the individuals fall down to a side and the male would then take hold of the female's tail with his tail, followed by insertion of his genitalia into the female (Fig. 1F). Copulation was male-initiated and was observed during the first observational night in lateral mounting position after an intromission latency of 170 minutes, and lasted for five minutes. Though pelvic movements were made by the male to achieve genital contact with the female, intermittent pelvic thrusting was not observed during copulation. The temporal patterns of mating behaviour including copulation and mounting events are given in Figure 2.

No copulation was observed during the second and third observational nights. A gradual decrease in time spent in exploration, chasing and mounting attempts was observed, as the female appeared to be avoiding the male, and frequently attained a retreat state (Table 1). The pair was then separated and returned to their enclosures.

Van Ee (1966) observed copulation in a pair of captive Cape pangolins (*Manis temminckii*) at the Bloemfontein Zoo, South Africa. During copulation the male mounted the female from the side, entwining her with his hind parts under hers (van Ee, 1966). This is very similar to our own observations. Fang & Wang (1980) stated that mature female Chinese pangolins (*Manis pentadactyla*) come into oestrus between late summer and early autumn. When more than one male is in the presence of a female in oestrus, the males fight violently until all but one leaves. A female in oestrus mates outside the burrow with a single male repetitively over a 3–5 day period. The male and female lie together on their sides, embracing with their forelimbs and swaying their heads. As in our observations and those of van Ee (1966), the male coils his tail with that of the female with his pelvis to one side of the tail. Copulation lasts for 3–5 minutes (Fang & Wang, 1980).

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Table 1: Mating and associated behaviours of a pair of opposite sex pangolins during three consecutive observational nights (ON).

Observed Behaviour	Total time spent (in min.) and (Frequency)			Bout duration (in min.) ± SD		
	ON-1	ON-2	ON-3	ON-1	ON-2	ON-3
Exploration (male)	51 (8)	25 (12)	9 (7)	6.4 ±2.0	2.1 ±0.9	1.3 ±0.5
Exploration (female)	13 (4)	9 (4)	4 (3)	3.3 ±1.3	2.3 ±1.3	1.3 ±0.6
Chasing	42 (8)	57 (12)	29 (7)	5.3 ±2.3	4.8 ±2.8	4.1 ±2.7
Mounting	77 (8)	120 (11)	51 (7)	9.6 ±6.1	10.9 ±5.7	7.3 ±2.0
Copulation	5 (1)	0	0	5	0	0
Retreat (male)	36 (5)	23 (4)	45 (8)	7.2 ±1.6	5.8 ±3.2	5.6 ±2.4
Retreat (female)	100 (6)	78 (10)	111 (9)	16.7 ±8.8	7.8 ±4.4	12.3 ±5.6
Clawing	26 (8)	39 (6)	61 (7)	3.3 ±1.0	6.5 ±1.2	8.7 ±2.7
No interaction	121 (8)	96 (8)	165 (9)	15.4 ±6.7	12 ±5.6	18.3 ±6.5

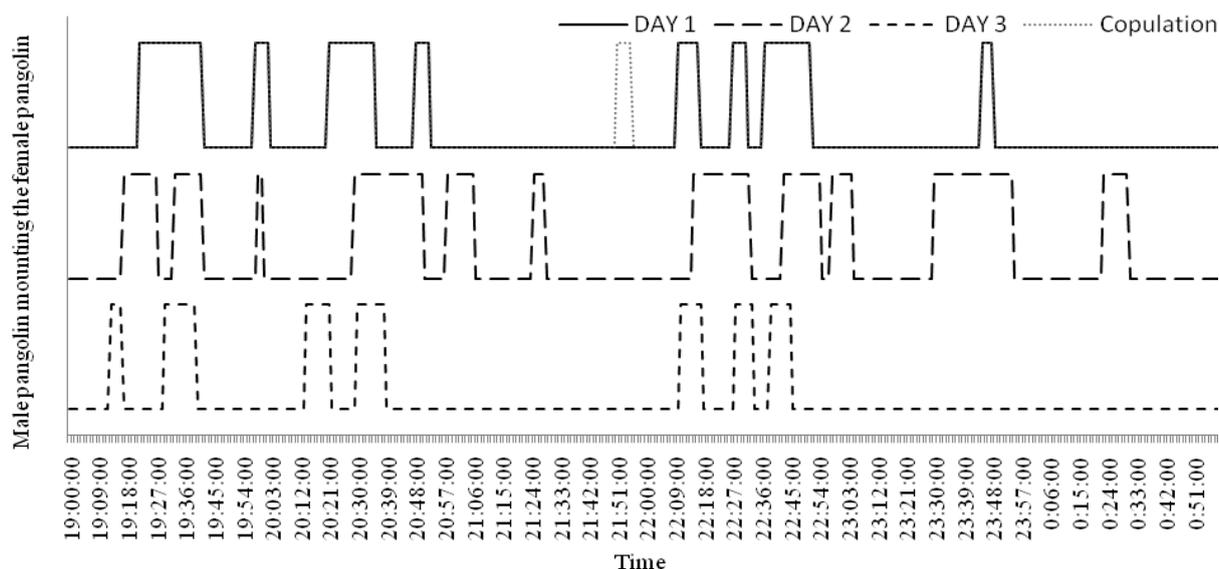


Figure 2: Temporal pattern of mating behaviour including successful mating (copulation) and mounting events (day 1, 2 & 3) of pangolin.

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PLATE 23

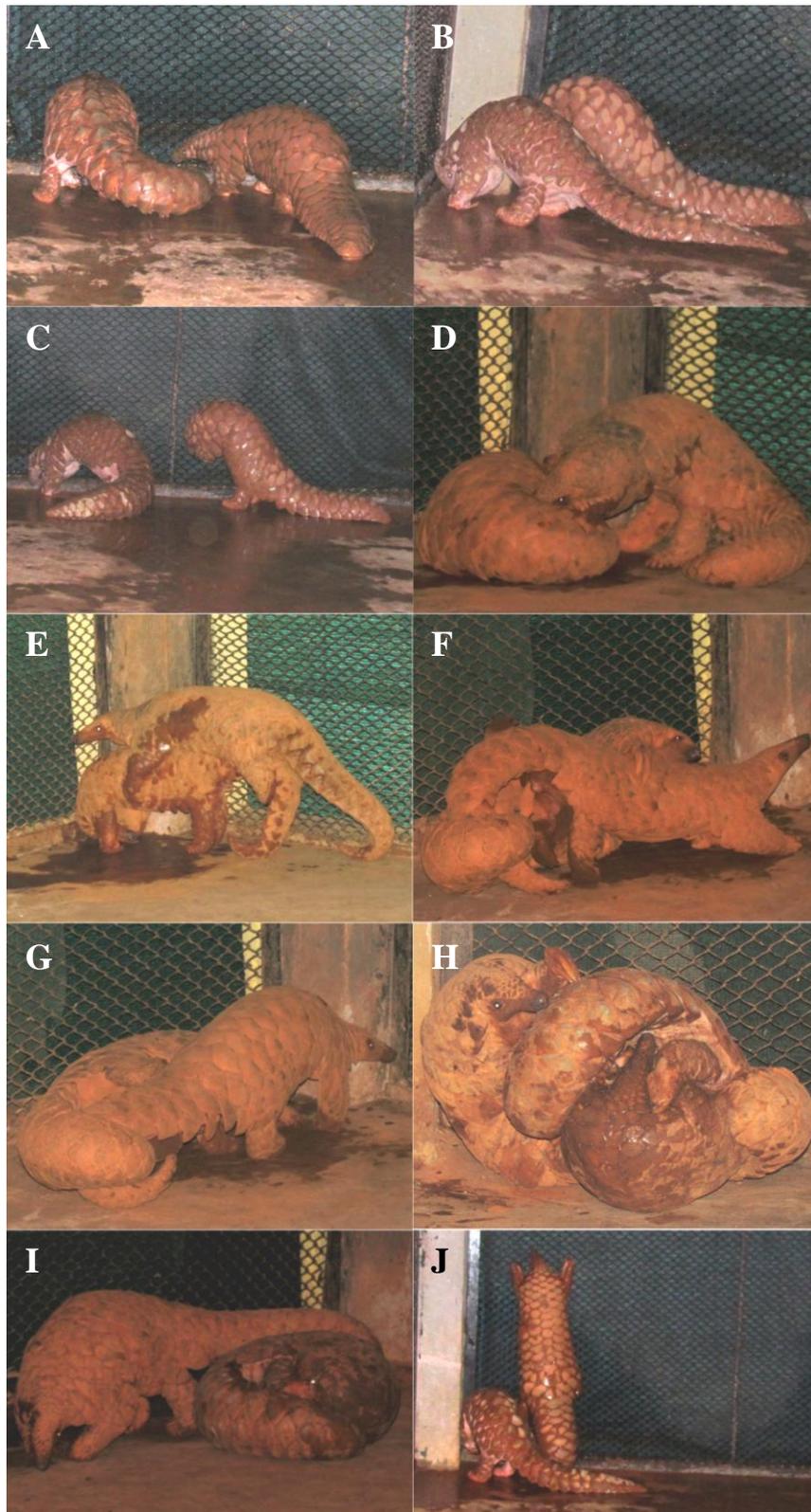


Figure 1: Mating behaviour of Indian pangolin, *Manis crassicaudata*, (A) male approaching female, (B) brushing: physical contact to stimulate female, (C) chasing, (D) noso-genital exploration, (E) mounting, (F) copulation, (G) termination of copulation, (H) clawing, (I) male walking away from retreat female, (J) female clinging on chain linked mesh.